Feasibility of Estimating Snow Depth in Complex Terrain Using Satellite Lidar Altimetry

Michael F. Jasinski Sc.D.
Hydrological Sciences Laboratory, Code 617
NASA Goddard Space Flight Center
Greenbelt, MD 20771
Tel: 301-614-5782

Jeremy Stoll M.S.
Science Systems and Applications, Inc.
NASA Goddard Space Flight Center
Greenbelt. MD

Abstract (Poster)

Satellite retrievals of snow depth and water equivalent (SWE) are critical for monitoring watershed scale processes around the world. However, the problem is especially challenging in mountainous regions where complex heterogeneities limit the utility of low resolution satellite sensors. The Geoscience Laser Altimeter Sensor (GLAS) aboard the Ice, Cloud, and land Elevation Satellite (ICESat) collected surface elevation data along near-repeat reference transects over land areas from 2003-2009. Although intended for monitoring ice caps and sea ice, the seven year global GLAS data base has provided unprecedented opportunity to test the capability of satellite lidar technology for estimating snow depth over land. GLAS single track and low repeat frequency does not provide data sufficient for operational estimates. However, its comparatively small footprint size of ~65 m and its database of seasonal repeat observations during both snow and no-snow conditions have been sufficient to evaluate the potential of space-based lidar altimetry for estimating snow depth. Recent analysis of ICESat elevations in the Uinta Mountains in NE Utah provide encouraging results for watershed scale estimates of snow depth. Research reported here focuses on the sensitivity of several versions of an ICESat snow depth algorithm to a range of landscape types defined by vegetation cover, slope and roughness. Results are compared to available SNOTEL data.